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CALIFORNIA DESERT AIR WORKING GROUP

DATA BASE STUDY

VOLUME 7 OF 7

FINAL REPORT

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EXECUTIVE SUMMARY

In 1981, a number of interested agencies and parties formed the California Desert Air Working Group (CDAWG). The intent of this group has been to cooperate and work towards a better understanding of air quality issues in the California desert from the Mexican border north through Mono County. The members of CDAWG have varying interests in the California desert, but all participants have one common need: an adequate data base for future planning and management of desert air resources. To accomplish this goal, CDAWG initiated a program to establish a common data base accessible to all members and other interested parties, and to perform some initial data analyses to begin developing a picture of current air quality. This program had several specific objectives:

- o To compile available air quality data into a single, consistently formatted data base that is accessible to all interested parties.
- o To provide the necessary study design and software to allow the addition of new data to the data base.
- o To identify factors related to the comparability, representativeness, and accuracy of data that may limit or enhance the usefulness of individual data subsets.
- o To develop descriptive statistical summaries of individual data subsets.
- o To carry out preliminary analyses addressing significant issues regarding desert air quality.

The desert data base study was sponsored by CDAWG and was performed under contract by Environmental Monitoring and Services, Inc. (EMSI), a wholly owned subsidiary of Combustion Engineering. The contract was financed by a group of CDAWG members composed of the Los Angeles Department of Airports, Los Angeles Department of Water and Power, San Bernardino County Air Pollution Control District, Southern California Edison Company, Southern California Gas

Company, United Stated Bureau of Land Management, United States Navy, and Western Oil and Gas Association (WOGA). In addition, WOGA also provided a Contract Coordinator (Dr. James R. Ouimette of Chevron Research Company) who assisted in tying the effort together.

EMSI has successfully completed all contract requirements and supplied all required deliverables. The major products of this study were:

- o A data catalogue summarizing and describing the data available at each site.
- o A set of data tapes containing air quality, visibility, and meteorological data for the California desert.
- o An extensive statistical analysis of the desert data base.

CALIFORNIA DESERT AIR WORKING GROUP (CDAWG) DATA BASE STUDY: Final Report

INTRODUCTION

The California desert consists primarily of the Southeast Desert and the Great Basin Valleys air basins; a map of the region is shown as Figure 1. In the desert, air quality, visibility, meteorological, and emission data are collected by several public and private organizations. In response to a need identified by the California Desert Air Working Group (CDAWG), a comprehensive catalogue and a data base of all reporting sites in the California desert have been compiled. It is hoped that a single, integrated data base will help to streamline the regulatory process and provide the information necessary to characterize the air quality baseline. The various tasks involved in compiling and evaluating the desert air quality data base are summarized in this report.

The California desert air quality data base study was performed under contract by Environmental Monitoring and Services, Inc. (EMSI), a wholly owned subsidiary of Combustion Engineering. EMSI successfully completed all contract requirements and supplied all required deliverables. EMSI's accomplishments included the following:

- o Accumulation of an extensive data base from numerous organizations which have been monitoring in the California desert. Air quality, visibility, and meteorological data are included.
- o Evaluation of the data base in terms of quality, comparability, and representativeness.
- o Production of a data catalogue summarizing and describing the data available at each site.
- o Development of computer software to convert disparate data to a common

Figure 1

CALIFORNIA DESERT: Selected Atmospheric Monitoring Sites

format, and production of a set of tapes containing the master data base.

o Performance of statistical analyses to characterize the data base.

o Production of a series of reports and other documents describing the progress of the work and providing information and assistance to users of the data base.

The program documentation was produced in seven volumes. A master table of contents for all volumes is included in this final report, and a brief description of each volume is provided below:

Volume 1 - Description of data catalogue structure and codes for representativeness, quality and comparability. Discussion of emission inventory.

Volume 2 - Description of proposed data base format.

Volume 3 - Criteria for selecting data for inclusion in the data base. List of selected categories of data. Objectives of statistical analyses.

Volume 4 - Summary of data base structure. Abbreviated catalogue (site, parameters, dates of operation, and data capture rate). Description of statistical analyses. Results of statistical analyses.

Volume 5 - Main data base catalogue. Alternate site indices (cross references by site code, county, and agency). Catalogue generating software. Parameter abbreviations and method codes.

Volume 6 - Detailed user's guide for the data base. File structure and format information. Method codes, pollutant codes, and unit codes.

Volume 7 - Final report. Summary of program goals and accomplishments. Discussion and interpretation of statistical analyses. Recommendations for further study.

Data Base Content

The overriding purpose of this project was to compile an integrated air quality data base for the California desert. Data were received from a number of different monitoring organizations and, where feasible, were converted to a common format. In some cases, format conversion was not possible due to technical or budgetary reasons, and in these cases the data were included in their original format. In other cases, data were received in hardcopy form and therefore could not be included because they were not machine-readable. The following list summarizes the data that were included in the data base:

1. Data from all California Air Resources Board air monitoring sites in the SE Desert and the Great Basin Valleys Air Basins;

2. All air quality and meteorological data from all non proprietary Southern California Edison air monitoring sites in the California desert;

3. Meteorological data from the National Weather Service for Bishop, China Lake, Cuddeback Lake, Edwards Air Force Base, George Air Force Base, Needles, Blythe, Silver Lake, Thermal, and Mojave.

4. Wind speed and directions for DWP pump #159, at Independence for 1977; the data were available on cards.

5. All air quality, visibility, and meteorological data from China Lake Naval Weapons Center (NWC) sites.

6. All air quality, meteorological, and visibility data from Army sites- Ft. Irwin and Death Valley

7. All meteorological and visibility data from EPA Las Vegas (EPA-LV)

sites- Ft. Irwin, Iron Mountain, and Edwards Air Force Base;

8. All meteorological data from San Diego Gas and Electric sites; and

9. Meteorological data for Lancaster from SCAQMD

10. Particulate research data from China Lake.

The data base is split into two parts. First, since the main thrust and the general interest of this program concerns air quality and visibility data, these data are included in one part, called Data Base I. As far as practical, all data were converted to a common format, which is an abbreviated version of CARB's master record format and covers both hourly and 24 hour data. Since several small data bases in special format were also obtained and could not be easily included in the master format, these were appended to the main data base in their original format. These exceptions were typically visibility data where visibility measurements are made thrice a day on several targets and using several wave lengths. All information to facilitate access to the data have been included in the documentation provided with the data base.

The second part of the data base (Data Base II) includes all other data (meteorological, upper air, micrometeorology, etc). Here no attempt was made to search for a common format, since a diverse collection of variables were involved. Since emissions are an important piece in the overall air quality puzzle, the latest available emissions inventory (1979) is also included in the second part of the data base.

It should be noted that the data have not been checked for errors; it is assumed that the data source is responsible for correcting errors in the data. However, whenever anomalous data were detected, every effort was made to correct them. For example, several mismatches between specified unit codes and the data have been fixed.

DATA SELECTION AND CLASSIFICATION

Data cataloguing, classification, and selection were accomplished as part of the first 6 tasks of the program and are summarized below.

Catalogue

Information about available air quality, visibility, or other related aerometric data for sites in the California desert were obtained by mailing a survey questionnaire to all agencies and research groups involved in air quality monitoring or research in the region. The response to the questionnaire was 100% and the information was augmented by personal contact. Where available, the data were also obtained.

Based on the available information, a revised catalogue of all reporting air quality, meteorology, and visibility sites in the California desert was compiled; governmental and private sites were included. The revised catalogue aims to furnish, in one compilation, all useful information pertaining to each site and its data. In a previous catalogue compiled by the Naval Weapons Center, China Lake, in 1981, site identification, site location, and periods for which specific data are available have been presented. In this revision, information on data quality, representativeness, completeness, measurement method, and comparability between multiple methods were added. Details of the catalogue and rationale for the classification schemes are described here.

The catalogue is intended to supplement the data base itself, which is described later. Hence, only sites for which data are available in the data base are included in the catalogue. The data selection procedure is also discussed later.

Catalogue Structure. In the catalogue, information is stored in each of 8 categories; comments are also included as needed. The details of the catalogue structure and the various codes used are included in the catalogue. The catalogue contains both factual information and judgmental information. Factual information includes:

site information: name, operating agency,data repository, etc;

location: address and co-ordinates (longitude and latitude, UTM, and township and range);

contact information: name and address of persons(s) directly responsible for the site from whom further information concerning the site can be obtained; and

parameter information for all parameters reported at the site: name of parameter, method code, measurement mode (daily,hourly, etc), and periods for which data are available.

To improve the value of the catalogue, data for each parameter at each site are rated according to 5 different indices. These judgmental indices and the rationale for their design are given below.

Data Classification

Each site was judged for its representativeness, predominant influence, and the purpose of the network to which it belongs. Data for each of the parameters reported at each site were rated for their quality, completeness, and comparability to other methods of measurement.

Representativeness. Representativeness indicates both the site location with respect to its surroundings and the representativeness of the data. Data representativeness is judged on whether the standard sampling methods are used (e.g. EPA, air-conditioned monitoring station) as well as whether temporally representative data are available, i.e. data for all seasons. The more closely standard methods are followed at a site and the more extensive (temporally) the data, the higher the representativeness. It is denoted by a six digit index and its details are given in the catalogue.

Purpose of Monitoring and Predominant Influence. Generally, monitoring sites belong to a network of sites; the network itself being established in accordance with some overall purpose, e.g., air monitoring, visibility monitoring, etc. Within the overall purpose of the network, sites are usually located in different areas (rural, urban, etc) as well as in special locations to monitor specific dominant influences (large power plant, traffic, etc). These are coded by a 5-character composite index; its details are given in the catalogue.

Data Quality. The overall quality of any data is determined by several factors: precision, accuracy, method of data collection and processing, calibration and operation procedures. Higher precision and accuracy are indicative of better data quality and hence result in a higher data quality index. Since automated data logging and computer data processing minimize the human error associated with manual operations, these are accorded the highest weight in the data quality index. Manual operations generally receive less weight.

If a standard operating procedure for quality control of the collected data is followed at a site, it results in a higher data quality index, the value being dependent on the extent and comprehensiveness of the procedure. However, in this case, a manual procedure is rated higher than a fully automated procedure, since weeding out bad data is somewhat subjective and better handled manually. Similarly, if standard operating procedures are available

and followed for site operations (operator training, routine maintenance, log books, etc), a higher data quality index is assigned.

Calibrations against traceable standards as well as the frequency of calibrations of monitoring instruments also count in the assignment of the data quality index. More frequent (e.g. weekly) calibrations using NBS traceable standards count towards a higher quality index.

Completeness. Data completeness is rated as a percentage of maximum possible data for the time period for which data are reported. For example, for hourly averages, one would expect a maximum of 365 x 24 values, whereas for TSP, measured only every sixth day, the maximum would be about 60. TSP completeness percentages can be greater than 100% if samples are collected more often than every sixth day.

Method Comparability Since different methods have been used for monitoring the same parameter at different sites, a comparability scale is used for rating each of the methods. Thus, the end user of the data base will have some quantitative measure of the weighting of different data. For this, all the methods used by CARB for each parameter are considered equivalent, and other methods are rated with respect to these equivalent methods, or to the most commonly used method if a CARB method is not available. These CARB methods rather than the EPA equivalent methods are used, since EPA equivalent methods are defined only for the criteria pollutants. All other methods are assigned a comparability code equal to published correlations between them and the reference method. It should be noted that correlations merely indicate the goodness of the one to one agreement between the two methods and are not to be used for conversions; that would require both a slope and an intercept. The reported correlations merely indicate whether two instruments respond similarly to a given change in ambient conditions; the correlation values do not provide a scaling factor for quantitatively adjusting data from one method to another.

DATA SELECTION

In the course of this program, air quality, visibility, and meteorological data have been received from various sources and of differing quality, completeness, and format. One of the objectives of this program was to compile a compact data base of available data for the California desert. Because of the effort required for the compilation of a computer accessible data base in a common format, it was decided that data of questionable value and quality will not be included in the data base. The data to be included were selected according to a set of criteria to be discussed next. Although comprehensive selection criteria were defined, they were applied in a flexible fashion, our philosophy being to err on the conservative side and include data of questionable value, so long as undue effort was not required for the task. Since the data quality, representativeness, comparability, etc. have already been rated by the comprehensive indexing scheme in the catalogue, the end user of the data base will have little difficulty in selecting data according to more specific overall data usefulness criteria.

Data Selection Criteria

The selection of data to be included in the data base is based upon a quantitative procedure which uses a ranking of the data quality, comparability, and representativeness in addition to the effort required to compile the data.

Data on Computer Tape. All data on computer tape satisfying the following minimum conditions were selected:

* At least one year's data

* Processed (as opposed to raw) data

* For air quality and visibility data, information must be available to

estimate the data quality and comparability of the data, even if the quality index ends up being poor

Since most of the available data sets include multiple sites, even if one site satisfied the above criteria all the data were included because the effort required to read and convert data on computer tape was nearly the same whether part or the whole tape was read.

Hardcopy Data (Strip charts, printout, etc.). Transcribing hardcopy data on to computer tapes requires substantial effort. Thus, we were more selective in including hardcopy data. In addition to the criteria listed above for tape data, hardcopy data had to satisfy the following criterion to be included:

* Must be spatially and temporally unique data, i.e., data for the same parameter and data for the same geographic area and same time period are not available on tape. From the end user point of view, if data are available on tape for a particular geographic area and time period, the additional effort required to transcribe a nearly duplicate hardcopy data set will not be cost effective.

In practice, most of the available hardcopy data did not satisfy the above criterion and, with one exception, were not included. Only wind speeds and directions for Indio for 1981 were transcribed from available hardcopy and included in the data base. This hardcopy data set was included because it was the only meteorological data available for that part of the desert.

EMISSION INVENTORY

Although it would have been desirable to include a more recent emissions inventory for California, the only complete and up to date emission inventory is available from the California Air Resources Board and is dated 1979. Thus, the unrevised 1979 emission inventory as been included in the second part of the data base. Both point and area sources are included. A complete inventory is believed to be compiled every 4 years with the next one dated

1983 expected to be available in 1985. If desired, this new inventory can be used to replace the 1979 data in the data base as soon as it is released. Recognizing that it would have been desirable to have an updated emission inventory for this project, every attempt was made to either revise the figures in the inventory or to at least assign uncertainty limits to them. For reasons discussed next, we were unable to achieve either.

CARB's emissions inventory program is an ongoing program where the data are constantly being reviewed and corrected. However, except once in every 2-4 years, the data for all sources are not reviewed and as such all revisions are considered preliminary and not approved for public dissemination. That is, the only current data which could be used to revise the 1979 inventory would be preliminary information of unknown validity. With regard to the question of uncertainties in the data, they would have to be estimated from more current figures. Since if the latter are available in validated form, they would be included in the data rather than be used merely for estimating uncertainties in older data, the task of assigning uncertainties to the 1979 inventory appears to be an exercise in futility.

An alternate procedure for revising the 1979 data would be to compile an independent inventory for the California desert. This would be an enormous task and is outside the scope of this program.

DATA PROCESSING AND CATALOGUE SOFTWARE

In this project, two classes of software were developed. One was the software for generating the catalogue; a copy is included with the catalogue. This code generates the current catalogue from a source file; a copy of a sample source file is also included in the catalogue. A complete source file is included in the data base tape. It should be noted that this code is not an interactive code. In other words, revisions and changes to the catalogue are accomplished by appropriate revisions to the source file. The catalogue can then be generated from the revised source file.

The second variety of codes were the format conversion codes. As noted earlier, data in several formats were received. Software was developed to convert each different format to the standard format selected for the data base. These codes are also included in the data base.

It should be noted that conversion codes were written only for those data converted to the standard format. As noted earlier, several data sets, e.g., teleradiometer visibility data, in the main data base and all data in the second data base, were not converted.

STATISTICAL ANALYSES

One of the purposes of compiling a common data base of information from various sources is that it will be useful and conveniently available for data analyses by interested end users. As part of this program the data were statistically characterized, and their results are presented in this section. Only rudimentary analyses were completed and were mainly intended to provide the end user, and the reader, with a general idea of the spatial and temporal distribution of the data, general correlations among important variables, and the frequency distributions of selected variables. More detailed and specific analyses were outside the scope of this program.

The statistical analyses were limited to Data Base I, which has a common format. Data Base II has a mixture of formats, and therefore cross-correlations and other statistical analyses would be more time consuming and out of the scope of this project. However, future users with more plentiful time and resources may wish to perform statistical analyses of Data Base II, which contains extensive meteorological data.

To meet the program objectives, the following statistical analyses were completed:

1. Calculation of monthly, seasonal, and annual means and standard deviations for O_3, SO_2, oxides of nitrogen, CO, and TSP at the following sites:

   Imperial;

   Indio;

   Barstow;

   Victorville;

   Trona;

   Lancaster; and

   Bishop (TSP only).

2. Calculation of monthly, seasonal, and annual mean and standard deviation of visual range, contrast or B- scat at all visibility monitoring sites.

3. Normal and log normal frequency distribution plots of the parameters and sites listed in 1 and 2 above.

4. Isopleth maps of the entire desert for O_3, SO_2, oxides of nitrogen, CO, TSP, and visibility using annual averages in 1977 and 1981.

5. Monthly time series plots of the parameters and sites listed in part 1 above for 1977 and 1978; wind directions will also be plotted where available.

6. Monthly time series plots of visibility data at all visibility monitoring sites.

7. Visibility roses:

   Visibility vs. wind direction

   Visibility vs. relative humidity;

   this was done for all sites which measure visibility and meteorological parameters concurrently.

Statistical Results

Extensive and detailed results of the statistical analyses are compiled in Volume 4. These results will be briefly summarized here. Any mention of appendices in this section will refer to Volume 4.

Turning first to Appendix B (Statistical Summary), we can see the results of calculations to give monthly, quarterly, and annual means. The annual means for ozone are similar at all sites in the desert, typically in the range of 25 to 40 ppb. However; individual high months can be considerably higher, in some cases reaching the 80 to 90 ppb range. The lowest monthly values are less than 10 ppb.

Sulfur dioxide is not measured at all of our selected sites, so the data base is somewhat limited. Most of the SO_2 monitoring stations that were analyzed have annual averages in the range of 3 to 8 ppb. Carbon monoxide is also measured at a limited number of sites, with most of these reporting annual averages in the range of 0.5 to 1.5 ppm. Generally, the highest CO annual averages were recorded at Indio and Lancaster, both of which had values in the 1.5 to 2.0 ppm range. These two sites have relatively large populations compared to other desert communities, and both are influenced by the Los

Angeles air mass.

Nitrogen oxides are measured at almost all of our selected sites. Annual averages for NO_x tend to vary from site to site, and even vary from year to year at the same site. NO_x annual averages typically range from 25 to 75 ppb, although the majority are in the range of 25 to 50 ppb. Barstow has had some of the highest annual NO_x values, with some above 80 ppb, whereas Trona has been consistently low, recording annual averages in the vicinity of 20 ppb.

Total suspended particulate (TSP) values show some of the greatest variability in annual averages. Bishop has reported values in the vicinity of 20 ug/m^3, while Indio reported several annual averages above 120 ug/m^3 in the early 1970's. Other sites have reported a variety of values in the range of 70 to 100 ug/m^3.

A number of stations have reported visibility (BSCT) values, primarily in recent years, and most report annual averages in the range of 0.3 to 0.7 $(x10^{-4})$ m^{-1}. Most of these sites are far removed from urban areas, so these values represent rural to near-pristine visibility conditions in the California desert.

Appendix C presents frequency distributions of the data on probability graph paper, shown in both linear and logarithmic form. The most interesting feature of these frequency distribution plots is that, for most analytes, the point of zero concentration (i.e. zero on the y-axis) corresponds to a decidedly non-zero cumulative percent of samples. In other words, many of the readings at most sites are recorded as zeros. This cumulative percentage value for zero readings ranges from just a few percent to over 90 percent, with many in the 20 to 60 percent range. Of course, many of the values which are recorded as zeroes are not truly zero, but are merely at the lower detection limit of the instrument.

The only consistent exception to the pattern of abundant zeroes in the cumulative frequency plots is TSP. With TSP readings, the zero concentration value typically corresponds closely to the zero frequency value. This occurs presumably because the precision of TSP values is primarily limited by the precision of filter weighings, which tend to be quite precise.

Time series plots for 1977 to 1981 are shown in Appendix D. Although most plots are rather erratic, there are several general trends which can be observed. First of all, ozone readings consistently peak in the summer, with maximum monthly averages ranging from approximately 50 to 70 ppb. Winter minima tend to fall in the 10 to 20 ppb range. Conversely, nitrogen oxides peak in the winter, with maximum monthly averages of NO_x in the range of 70 to 100 ppb. Summer NO_x readings exhibit minimum values of 10 to 20 ppb.

TSP tends to peak in the summer, but its behavior is more erratic than that observed for ozone and nitrogen oxides. Summer peaks range from 40 to 120 ug/m^3, with winter valleys ranging from 10 to 70 ug/m^3. At Trona, however, the most prominent TSP peaks occur in the winter (around 220 ug/m^3), with summer valleys around 100 ug/m^3.

Carbon monoxide is very erratic, with no apparent seasonal tendencies. Visibility (BSCT) also tends to be erratic, although some sites lean toward lower scattering coefficients (i.e. greater visibility) in the winter, with corresponding higher BSCT values in the summer.

Appendix E contains maps of the California desert which show the spatial distribution of the various pollutant species in 1977 and 1981. The density of available data is rather sparse in many of these maps, but a few general conclusions can nevertheless be made. First of all, the highest annual mean TSP concentrations are found in the Imperial Valley, with values well above 100 ug/m^3 in both 1977 and 1981. Annual means at most other desert sites are in the range of 30 to 70 ug/m^3. Most ozone means are in the vicinity of 30

ppb. However, in both years there was a tendency toward slightly higher readings in the areas surrounding Los Angeles (Lancaster, Victorville, Indio). The spatial density of other parameters was too small to draw any meaningful conclusions.

Appendix F presents plots of visual range versus relative humidity for sites which measure both quantities. It is interesting to note that there is no obvious correlation between visibility and relative humidity. Even though one might expect to see a correlation, particularly at high humidities, there appears to be no decrease in visual range with increasing moisture at the California desert sites.

Appendix G contains visibility roses, which show the wind direction dependency of visibility plotted for all sites which report both quantities. None of the sites have a striking preference for any particular wind direction to achieve good visibility (i.e. good visibility can occur with virtually any wind direction). Nevertheless, many sites have a prevailing wind direction (or directions) with a high frequency of occurrence. Coso (in the China Lake area) shows predominant north and south-southeast winds, whereas Edwards, farther to the south, favors west to west-southwest winds. Fort Irwin also experiences predominant west-southwest winds. Death Valley and Iron Mountain both experience southerly winds; Iron Mountain also has a strong west-northwesterly component.

RECOMMENDATIONS

The following recommendations are offered in an effort to improve data collected in the future as well as to increase the usefulness of the data base.

Data Base

A custodian for the data base is recommended so that the data base can be periodically revised as additional data become available. The custodian should serve as a central distribution point for any revised data tapes and/or supporting documentation. Furthermore, a procedure or form is recommended for users to transmit errors which they find in the data to the custodian.

An important goal for the data base custodian should be to add data from the most recent years (1983-84). Due to ever-increasing instrument quality and, in many cases, improved quality control techniques, the most recent data can be expected to be generally more reliable than that collected in prior years. Also, the extension of the time series plots by several additional years may cause trends of increasing or decreasing air quality to become apparent. With the existing data base, it is not possible to see any definitive trends in the data.

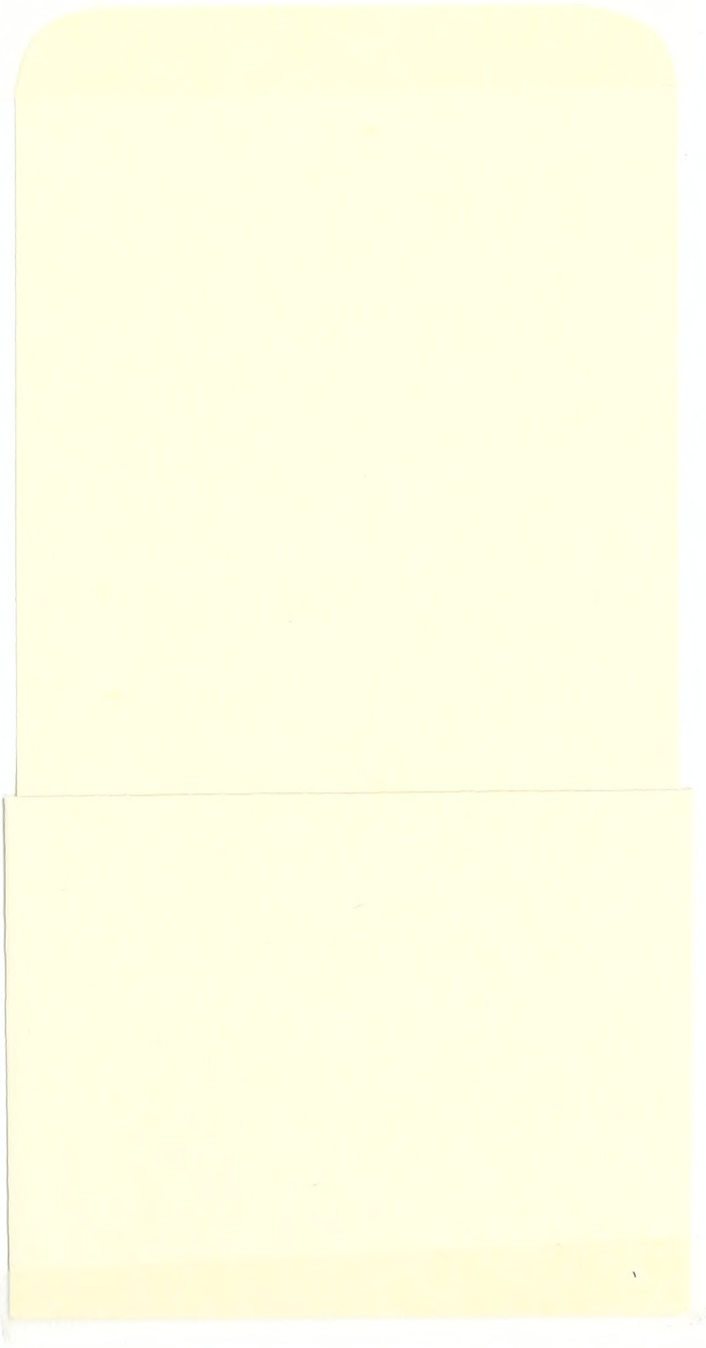
Additional Monitoring

It is not possible to draw meaningful concentration isopleth maps for the California desert because certain areas do not have an adequate density of monitoring stations. Most obvious is the eastern Mojave (a triangle roughly bound by Barstow, Needles and Las Vegas), which is not represented in the current data base. Data will be available soon from Ivanpah and Cima for updated versions of the data base, but even the addition of these two sites will not adequately define the spatial variation of air quality in the eastern Mojave. If meaningful isopleth maps are desired, it is recommended that additional monitoring sites be established in the eastern Mojave. These sites will serve an additional function of allowing the Los Angeles air mass to be tracked as it traverses southeastern California. There is a great deal of concern about the effect of Los Angeles upon air quality in Nevada, Utah and Arizona, and the trajectories of interest pass through the eastern Mojave.

Statistical Analyses

The statistical analyses conducted here were limited by the scope of this project. Additional statistical analyses are essentially limitless, and should be chosen to meet the particular needs of the users of the data base. Two possibilities seem especially promising: 1) Utilize the extensive meteorological data available in Data Base II, which was not used in the current analyses, and 2) Perform factor analysis to attempt to determine the contributions of various emission sources. For example, the lead/bromide ratio on particulate filters can help to distinguish between vehicular and non-vehicular pollution.

Quality Control

The quality control for the monitoring as well as for the data varies widely for the different organizations. For the sake of uniformly high quality, it is recommended that future monitoring programs follow standard quality control and operating procedures, such as those used by EPA or CARB.

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